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NOTES ON A EUROPEAN WEEVIL, CEUTORHYNCHUS ASSIMILIS PAYK., RECENTLY FOUND IN THE STATE OF WASHINGTON.

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During May, 1935, C. F. Doucette[1] collected a few adult weevils on flower heads of mustard growing at the edge of a bulb field near Lynden, Wash. These weevils were recognized by the writer as apparently different from any of the species listed from North America, and a trip was made to Lynden on June 1, 1935, to obtain additional specimens. Specimens were also collected on mustard close to the northern limits of Bellingham, at two points between there and Lynden, north of Lynden, and in the vicinity of Nooksack, all in Watcom County. On the following day two specimens were collected on mustard at Big Lake, Skagit County. Big Lake is practically in the seed-growing section of the county, where a large portion of the cabbage seed used in the United States is produced. Weevils were determined by L. L. Buchanan[2] as *Ceutorhynchus assimilis* Paykull, and Mr. Buchanan stated that this species had not previously been reported from North America and that it appeared to be of considerable economic importance in Europe.

This weevil is known in Europe by several common names, such as "turnip seed weevil," "radish seed weevil," and "cabbage shoot weevil," the last name being given in Morstatt's "Preliminary Check list of Common Names Used in Applied Entomology." (*4*) [3]/.

The following notes on host plants, life history, and control were abstracted from the condensed reports of European papers appearing in the Review of Applied Entomology, Series A. Various articles list it as attacking turnips in England, as being found on turnips, radishes, and cabbage in Denmark, as attacking rape in Germany, as destroying the ripening seed of broccoli in Great Britain, and as associated with *Ceutorhynchus syrites* Germar on mustard in Russia.

Heymons, in a paper on the development of this weevil on rape in Germany (*2*), states that the adults appear early in the spring before the rape blossoms and feed on the flower buds and stalks both day and night, but he considers this early feeding to be unimportant. When the pods appear, the adult female bores a hole in the pod with its beak and then deposits an egg beside or within a young seed. After feeding within the pod on the developing seeds for 4 or 5 weeks, the larva cuts a hole in the pod and drops to the soil to pupate. The adult emerges from the soil in about 10 days. Only one generation a year was observed.

Wolff and Krausse (*9*) list crucifers as hosts, with mustard leading. They found that the female laid from one to three eggs in the very young pods, the

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[3] Figures in parentheses refer to literature cited.

larvae often destroying every seed in the pod. Pupation took place in the soil at depths of from 1½ to 2½ inches, and the pupal stage lasted from 2 to 4 weeks. They found that the young adults usually appear before mid-July and, together with the overwintered adults, feed on the buds and flowers. The sexually immature adults hibernate in the stubble or superficial ground layer and usually emerge by mid-April. In warm weather they have a very active flight period.

Staniland and Beaumont (*7*), working in England, report that the eggs are laid in the seed pods or immature seed vessels of broccoli in Devon and Cornwall and that the larvae feed on the pistils and unripe seeds. Severely infested pods usually open early, and the mature larvae drop to the soil and pupate at a depth of about 2 inches. These investigators believe that there are probably two generations a year.

Heymons (*2*) records the pteromalid *Trichomalus fasciatus* Thoms. as a parasite and one which apparently had not been previously reported from this host.

Voss (*8*) recommends as control measures collection of the adults and deep plowing after the crop has been harvested, as well as the use of good cultural practices to insure strong, thrifty plants. Lang (*3*) mentions collecting the weevils with an apparatus consisting of sticky boards which are swept over the plants, and that spraying the plants with Urania green gave good results. Wolff and Krausse (*9*) consider deep plowing under of the stubble a direct control measure.

Staniland and Beaumont (*7*) state that derris or pyrethrum sprays would probably control the weevil. Rademacher, in discussing the advantages and disadvantages of crop rotation (*5*), mentions that the damage caused by this insect has been checked when an increase in acreage of cereal crops has caused a big decrease in the growing of cruciferous oil crops and that future damage can be lessened by crop rotation in large areas.

Blunck (*1*) lists several arsenical preparations that have been used against the pest in Germany, but states that none of them has given satisfactory results, *Ceutorhynchus assimilis* showing the same resistance to arsenical compounds as the cabbage flea beetle. He believes that control might be effected more easily in a mechanical way and might be combined to good advantage with control of the Nitidulariae.

Speyer (*6*) states that *Ceutorhynchus assimilis* is a dangerous pest of rape. The pteromalid *Trichomalus fasciatus* Thoms. may, perhaps, under favorable conditions, increase sufficiently to check this weevil in spite of the fact that only one generation parasitizes the weevil, larvae being found in those of *C. assimilis* only during a fortnight in June. Control measures are necessary only if the weevil is abundant or if the pod midge, *Dasyneura* (*Perrisia*) *brassicae* (Winn.), is injurious. Such work must consist chiefly in mechanical collection.

No opportunity was afforded during the summer to obtain additional information on the status of this weevil in Whatcom and Skagit Counties, but on November 12 a few dried seed pods of mustard were collected north of Lynden and brought to the laboratory for examination. Nearly all the pods gave evidence

of damage by weevil larvae, and, since the damage is similar to that caused by this weevil in Europe, and there is no similar damage recorded for other weevils in this country, it seems possible to infer that *Ceutorhynchus assimilis* is responsible for this injury. Many of the pods evidently had been infested by only one larva, and in such pods not all the seeds were destroyed, but in many pods there was evidence of infestation by two or three larvae, and in all these pods all the seeds were destroyed. Molted head shields of the larvae, and in some cases dead weevil larvae, were found next to the injured seeds. Four dead hymenopterous parasites were found, representing at least two distinct groups; these were in poor condition and it is doubtful if a positive identification can be obtained.

The weevil *C. assimilis* is established in Whatcom County, Wash., and is present, at least in small numbers, in the seed-growing sections of Skagit County. Just how this may affect the production of cabbage and other cruciferous seed crops remains to be seen, but, judging from what is known of this insect in Europe, it may become a factor of considerable importance to the growers of such crops. The fact that the pupae have been found in turnip seed in Great Britain brings out the possibility that it may be disseminated through seed shipments to sections now free from it, if the seed is not treated. In sections not producing cruciferous seed crops, the weevil might be of some benefit in reducing the set of seed of cruciferous weeds, but control of weeds by introduced insects is usually of questionable value.

LITERATURE CITED

(1) Blunck, H. 1922. Uber die Wirkung Arsenhaltiger Gifte auf Oelfrucht-schadlinge nach Beobachtungen an der Naumburger Zweigstelle der Biologischen Reichsanstalt. Verhandl. Deut. Gesell. Angew. Ent. 3: 40-55.
(2) Heymons, R. 1921. Mitteilungen uber den Rapsrussler, *Ceutorrhynchus assimilis* Payk. und Seinen Parasiten, *Trichomalus fasciatus* Thoms. Ztschr. Angew. Ent. 8:93-111, illus.
(3) Lang, —— 1921. Bericht der Wurtt, Landesanstalt fur Pflanzenschutz Hohenheim uber Rapsglanzkaferbekampfung. Nachr. Deut. Pflanzenschutzdienst 1 (2): 10-11.
(4) Morstatt, H. 1924. Preliminary Checklist of "Common Names" Used in Applied Entomology. Supplementa Entomologica, No. 10, 56 pp., Berlin.
(5) Rademacher, B. 1933. Gedanken zu der Geplanten Ausdehnung des Oelfruchtanbaues vm Standpunkte des Pflanzenschutzes. Mitt. Deutt. Landw. Gesell. 48:520 (Abstr. in Ztschr. Pflanzenkrank. 43 (10): 621.
(6) Speyer, W. 1925. Kohlschotenrussler (*Ceutorrhynchus assimilis* Payk.) Kohlschotenmucke (*Daysneura brassicae* Winn.) und Ihre Parasiten. Arb. Biol. Reichsanst. Land-u. Forstw. 12:79-108, illus.
(7) Staniland, L. N., and Beaumont, A. 1932. Ninth Annual Report of the Department of Plant Pathology for the Year Ending September 30th, 1932. Seale-Hayne Agr. Coll. Pamplet No. 40, 43 pp., illus. Devon.
(8) Voss, G. 1919. Rapsglanzkafer and Rapsverborgenrussler. Schaffnits Flugblattsammlung uber Pfanzenschutz, Bonn-Poppelsdorf, Flugblatt No. 14. (Abstr. in Ztschr. Landw. Versuchsw. in Deutschosterreich 22:193, 1919).
(9) Wolff, M., and Krausse, A. 1921. Ein Nachwort zum Streit uber den Rapsglanzkafer. Illus. Landw. Ztg. 41:243-244, 250-251. (Abstr. in Centrbl. Bakt. (etc.), Abt. 2, 56: 435-437.

THE FLEAS OF BRITISH COLUMBIA.

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The present article is based on a study of the collection of fleas belonging to Prof. G. J. Spencer, of the University of British Columbia, Vancouver, B. C., and of the collections made by the late Mr. Eric Hearle of the Dominion Entomological Laboratory, Kamloops, B. C. It is an agreeable duty to me to express my

most sincere gratitude to Prof. G. J. Spencer as well as to Dr. Arthur Gibson, Dominion Entomologist, and Dr. J. McDunnough, Chief of the Division of Systematic Entomology, Entomological Branch, Department of Agriculture, Ottawa, Ont., for having afforded me the opportunity of becoming more closely acquainted with the aphanipterological fauna of British Columbia. It was especially interesting to me as the fauna of this province is largely allied to that of the eastern part of the palaearctic region.

The fauna of the western area of North America is far richer than that of the eastern area, a fact which was pointed out by Jordan in his article on the distribution of the North American Aphaniptera (1929). According to his information in 1929, out of 131 neoarctic species not less than 107 inhabit the western area of the North-American continent, whereas in the eastern area we find but 31, and in the central area, which separates the two zones, 26. At present the number of established North American species—not to speak of those imported from other parts of the globe—attains almost 160; the greater part of them was described from the western area of the continent. As far as Canada is concerned its most westerly province, British Columbia, appears to be particularly rich in fleas as we find here more than 1/3 of all the North-American species known to date. When comparing them with the palaearctic fauna we find here a certain number of species which coincide with the species of East-Asia and genera which distinctly remind one of the Asiatic ones, which cannot be said of the species indigenous to the Eastern portion of the American continent. Such a similarity supports one theory of a comparatively recent immediate connection between North America and East-Asia. This fact deserves an attentive study from the standpoint of the distribution of Asiatic and North American Mammalia, a task, however, which does not enter into the scope of the present article. I take the liberty of noting in the list of the fleas of British Columbia some instances of the parallelism between its aphanipterological fauna and that of Asia.

A systematic study of the fleas of western North America and particularly of the Rocky Mountain area is further of interest in connection with the sylvatic plague recently reported in Montana. In this case it is of importance to state the true hosts of the different flea-species and therefore, as far as possible I give in my list such indications; in many cases, however, the collected material to date as well as the information in the literature is not sufficient.

PULICIDAE Tasch.

*1. *Hoplopsyllus glacialis lynx* Bak. 1904. Unique representative of the family *Pulicidae* found up to date in B. C. (not counting of course *Pulex* and *Ctenocephalides* imported from the Old World). *H. glac. glacialis* Tash 1880, described from the "North Pole," is a circumpolar species; farther southwards live its races: in America—*H. glac. lynx,* in Asia—*H. glac. profugus* Jord. 1925. *H. glac. lynx* was noted first by Baker from the state of Idaho, yet according to Jordan the species extends further southward, whereas in the East, outside of Canada, it has only been noted from Maine and New Brunswick. In my collection there are *H. glac. profugus* from Turkestan and Sayan Mountains. Thus a certain parallelism in the distribution of this flea in the west of N. A. and the east of the palaearctic region can be stated. Proper hosts-different species of *Lepus;*

characteristic for *H. glac. glacialis-Lepus americanus;* for *H. glac. profugus,* after my observation, *Lepus tolai.* Occasionally it passes over to carnivore Mammalia, which chase hares (*Lynx, Felis, Canis, Putorius, Alopex* etc.). The Spencer collection from B. C. contains several individuals from *Lepus americanus* and *Lynx fasciatus.*

VERMIPSYLLIDAE Wagn.

2. *Arctopsylla ursi* Roths. 1902. Was found on *Ursus horribilis,* Alberta, almost at the frontier of B. C. (45 miles westwards from Calgary) and is doubtless to be met with in B. C., for like its near palaearctic relation, *A. tuberculaticeps* Bezzi, living on *Ursus arctos,* it represents a monozoid parasite. Consequently its area and that of its host must nearly well coincide. A good specimen of a vicariating species.

*3. *Chaetopsylla setosus* Roths. 1906. A female was described from B. C. (Mabel Lake) from *Ursus americanus.* The collection of Spencer contains 1 ♂ from *Ursus horribilis bairdi.**) It is interesting to note that in N. America, besides *Ch. setosus,* there is found only one other species of *Chaetopsylla* (*Ch. lotoris* Stew. 1926), while in the palaearctic region there are known 9 species. All these live on Carnivora.

CERATOPHYLLIDAE Dampf.

Subfam. Ceratophyllinae Dampf.

4. *Amphipsylla sibirica pollionis* Roths. 1905. I consider *A. pollionis,* found on *Microtus drummondi* and *Evotomys suturatus* in Alberta (Red Deer) not as a particular species, but as a North-American race of *A. sibirica* Wagn. 1898 (*nec* 1900!), which is a circumpolar species. This explains the fact, which appears strange on first sight, that the species is found in Canada, whereas all other 14 species of *Amphipsylla,* known up to date, live in Siberia, Manchuria, Mongolia and China and only four of them, not to count *A. sibirica,* extend their area a little westwards of the Ural and Caucasus. The only exception is *A. sibirica* whose different races are encountered in the Alps of middle and south Europe. There is no doubt, that the North American race, *A. sibirica pollionis,* is not limited to Alberta, but will be found also in the mountainous districts of B. C. All races of A. *sibirica* live on different Microtinae species (*Microtus, Evotomys, Pitymys* etc.) and move temporarily from mice to martens and weasels.

5. *Ctenophyllus terribilis* Roths. 1903. Is found on *Ochotona princeps* in Alberta (Banff, Canadian National Park), but doubtless its area extends into B. C. It is the unique North American representative of that group of *Ceratophyllinae,* which possess a fully developed stick-like fore-part of the tentorium of the head, characteristic for a number of genera of the palaearctic region. The other known 3 species of this genus live on different *Ochotona* species in East Siberia. *C. terribilis* is the nearest relation of *C. subarmatus* Wagn. 1900, from Altai. Thus *C. terribilis* is a connecting link between the fauna of B. C. and that of East Asia.

*6. *Megarthroglossus longispinus* Bak. 1895. The small but very characteristic genus *Megarthroglossus* is limited to the western area of N. America. Up to date it is found nowhere else. For B. C. it is especially characteristic, for out of the 4

*) It is described by me in Zeitschrift f. Parasitenkunde, 1936.

described species 2 are known only from B. C., in addition there are the 3 new species, also from B. C., in the Spencer collection and the Dominion Entomological collection, which are described further on. To judge by the rudimentary eyes the representatives of the genus must dwell chiefly in the nests and holes of their hosts. In general they are but seldom encountered. *M. longispinus* was described from the state of Colorado (Georgetown) from *Sciurus fremonti* (Fremont's Chickaree); later, in a more detailed manner, by Jordan and Rothschild from Canada, Rocky Mountains (Red Deer River, Alberta) from *Sciurus richardsoni baileyi* and from *Mus.* sp.; Dunn and Parker mentioned in from the state of Montana from *Sciurus hudsonicus.* The collection of the Kamloops Laboratory contains 1 ♀ from B. C. (Avola, 2.IX.32) from *Sciurus duglasii.* Jordan and Rothschild point out that "in the ♀ the seventh sternite often has a very distinct apical sinus." This sinus in the ♀ from Avola surprises by its bigness and I propose to name this variation EXSECATUS var. nov. The type is No. 4112 in the Canadian National Collection, Ottawa.

7. *Megarthroglossus sicamus* Jord. and Roths. 1915. Described from B. C. (Eagle River, Sicamous) from *Canis latrans,* on which it was found by chance. In the Kamloops collection there is 1 ♀ from *Neotoma cinerea occidentalis* (Rutland, B. C., alt. 6000', 19.VIII.31.).

8. *Megarthroglossus procus* Jord. and Roths, 1915. Rothschild's collection contained a small series of both sexes from Chilliwack, B.C., collected on *Spilogale* and 1 ♂ on *Peromyscus.*

9. **Megarthroglossus similis** sp. n.

According to the structure of genitalia (Fig. 1) occupies a position between *M. procus* and *M. longispinus.* Acetabular-bristle well developed. The form of gonopode, as in *M. longispinus,* but endopodite located as in *M. procus.* Posterior margin of the gonopode slightly concave. 9 sternite as in *M. procus.* but the horizontal part comparatively longer and the apical end, bent up, wider. Fifth segment of the fore tarsi with 3, of the hind tarsi with 2 plantar bristles anterior to the claws. Spencer's collection contains 2 ♂ ♂ from *Neotoma cinerea occidentalis* (Beaverdell, B. C. 23.XI.30.).

*10. **Megarthroglossus spenceri** sp. n.

Differs from the former species as follows. The occiput of the head (Fig. 2) with 1 bristle only, corresponding to anglebristle (i.e. the inferior of posterior margin row). Metanotum very short with only 4 bristles on each side, 6th tergite with 5, the 7th with 3 bristles on each side. On the outer surface of the hind femora in their proximal half no bristles. One of the apical bristles of the 2nd segment of the hind tarsi reaches to 2/3, the other to 1/3 of the 5th segment. The last tarsal segment of the fore legs bears 4, of the hind legs 3 subapical plantar bristles, placed in one cross-row. 7th sternite considerably narrowed backwards (Fig. 3) with a rounded apical angle near the ventral middle line. Recept. seminis as in *M. longispinus,* but the distal half of the reservoir spheric. Holotype, 1 ♀ from *Ochotona princeps,* Bangs Nicola, B. C. (26.VIII.32) in Coll. Spencer.

*11. **Megarthroglossus pygmaeus** sp. n.

The Kamloops collection contains 1 ♂ from *Neotoma cinerea* (Nicola, B. C.,

25.VIII.32). Very near to *M. longispinus* and *M. sicamus,* but differs from them in certain details of structure of genitalia. I am not sure whether this species is distinct, as there is a named species, known only by 2 ♀ ♀, *M. bisetis* Jord. and Roths. 1915, found also on *Neotoma*—state of New Mexico, which is also stated to be near to *M. longispinus.* Apical margin of the 8th sternite (Fig. 4) with a lateral ventral rounded salience less protruding than in *M. longispinus.* Endopodite with a distinct angle on the anterior margin approximately on the level between the apex and the middle third. The apex of the horizontal arm of the 9th sternite more narrowed than in *M. longispinus* and *M. sicamus.* Paramere with a dorsal hook as in *M. sicamus,* but in addition at the ventral margin there is a sharp claw-shaped salience, directed towards the base of penis, as is shown in the drawing (Fig. 4). The holotype is No. 4113 in the Canadian National Collection, Ottawa.

12. *Callistopsyllus terinus* Roths. 1905. The genus *Callistopsyllus* is as characteristic as *Megarthroglossus.* Its characters bring it near to *Anomiopsyllus* from the western states (California, Arizona). Up to date there is known only a ♀ from *Citellus columbianus* (Mabel Lake, B. C.); true host—unknown.

*13. *Thrassis acamantis* Roths. 1905. All species of the genus *Thrassis* described to date are limited to the western states of North America and the western part of Canada. They are known from California, Arizona, Utah, Colorado, Idaho and Montana; in Canada from B. C. and Alberta. Therefore it is probable that the distribution of this genus coincides more or less with the mountainous district of the Rocky Mountains from which the fleas wander to California over the Wahsatch Mts. and the Colorado Plateau. As concerns *T. acamantis,* its area in Canada coincides with that of *Marmota flaviventris,* this flea being a special parasite of this animal. It only occasionally occurs on other mammals. In B. C. *acamantis* is very common; Mr. Spencer's collection and the Kamloops collection contains numerous specimens collected from *Marmota flaviventris* and from the following localities (Black Pines, Boulder, Chinook, Cove, Darlington, Falkland, Hat Creek, Heffley, Janieson, Kamloops, Lake Road, Mt. Olie, Nicola, Rayleigh, Roundtop, Salmon Arm, Shuswap, Tranquille, Trapp Lake, Vinsula, Westsyde). In the South, in California, it is replaced by an allied species, *T. howelli* Jord. 1925, which, probably, is but a race of *T. acamantis.*

*14. **Thrassis spenceri** sp. n.

Reminds one of *T. acamantis,* but proboscis considerably shorter and extending but little beyond the anterior trochanter. Lower antepygidial bristle in ♀ but little shorter than the middle one. 8th tergite in ♂ becomes gradually wider downwards, ventral apical angle broadly rounded, produced not backwards; it bears some 10 short ventral bristles (Fig. 5). The basal part of the exterior part of the chitinous apparatus of penis, which is a good sign for distinguishing *T. acamantis, T. spenceri* and *T. stanfordi,* with a right ventral angle, which is not extended into a process (in *T. acamantis* this angle is extended into a long narrow process; Fig. 6). The end of the paramere of penis pretty broad (Fig. 7A) having a rounded apex (in *T. acamantis* it is narrow beak-shaped; Fig. 7B). In ♀ apical margin of the 7th sternite without a sinus beneath the rounded dorsal angle.

Holotype and Allotype 1 ♂ and 1 ♀ in collection of Kamloops from *Mar-*

mota sp. (Hoary marmot, Alpine), Birch Island, B. C., 7000′ (12.VIII.31); No. 4111 in the Canadian National Collection.

*15. *Oropsylla arctomys* Bak. 1904. The genus *Oropsylla* is distributed over N. America and the palaearctic part of Asia. Two species of it extend their area to south-eastern Russia. Is not found in western Europe. Its typical hosts marmots and ground squirrels. *O. arctomys* lives on *Marmota monax* and is but occasionally found on other Mammalia. This species was described from the state of New York, but its area must coincide with that of *Marmota monax*. Collection of Kamloops Laboratory contains the species from Black Marmot (*Marmota monax petrensis?*) from Vavenby, B. C. (11.VIII.31).

*16. *Oropsylla idahoensis* Bak. 1904. As widely distributed as the former species. Its typical host *Citellus columbianus*. First described from the state of Idaho; was noted in large numbers from the same host by Dunn and Parker from Montana; was described from Alberta by Rothschild under the name *C. poeantis*. This species varies considerably. Collection contains numerous specimens of it from *Citellus columbianus* from different parts of B. C. (Birch Island, Blackpool, Roundtop, Rutland etc.).

17. *Oropsylla rupestris* Jord. 1929. A species near to the preceding; described from Alberta (Calgary and Blackfalds) from *Citellus richardsoni, Thomomys and Putorius*. In my opinion must occur in B. C. Its probable host—*Citellus richardsoni.**)

*18. *Foxella ignotus recula* Jord. and Roths. 1915. An oddly transformed species belonging to the same group as the genera *Oropsylla* and *Thrasis*. *F. ignotus ignotus* Bak. 1895 was described from the state of Iowa from an unknown host. The typical host of *F. ignotus* must be considered to be *Thomomys*, yet it is encountered also on *Geomys*, occasionally on weasels, martens and ground squirrels. The species is widely distributed in the western area of N. America and probably does not extend eastward of the Mississippi River. Jordan and Rothschild recognize only one species, *F. ignotus*, considering that *F. franciscanus* Roths. 1910 (from *Thomomys bottai*, California) and *F. apachinus* Fox 1914 (from *Cynomus arizonensis*, New Mexico) are merely its races **); moreover they distinguish still another race, *F. ign. albertinus*, (=*ignotus* Roths. 1910) from Alberta and the first named *F. ign. recula* from B. C. Spencer's and Kamloops collection contain specimens from *Thomomys fuscus fuscus* (Kamloops, Hedley), *Putorius arizonensis* (Monte Creek, Peterson Ck.) and *Mustela suturata* (Nicola Ranges).

19. *Dactylopsylla comis* Jord. 1929. The genus is close to the preceding but is more specialized. 1 ♀ *D. comis* is described from *Thomomys fuscus*, Okanagan Landing, B. C.

20. *Opisodasys versperalis* Jord. 1929. Described from *Sciuropterus alpinus* from Okanagan and Okanagan Landing, B. C.

*21. *Opisodasys keeni* Bak. 1896. Described from Queen Charlotte Islands from *Peromyscus*. Spencer's collection contains specimens from *Peromyscus*

*) The genus *Opisocrostis* (Jord.), very near to *Oropsylla*, some species of which live on groundsquirrels (*Citellus columbianus, C. 13-lineatus, C. richardsoni*) in Alberta and Saskatchewan, is not found up to date in B. C.

**) As concerns *F. apachinus* Fox I am cherishing some doubts.

maniculatus from Aspen Grove, B. C. *Peromyscus* seems to be its usual host.

*22. *Orchopeas sexdentatus agilis* Roths. 1905. At first I separated the genus *Orchopeas* from *Ceratophyllus* under the name *Bakerella* (1930), which however became a *nomen praeoccupat.* and was changed by Jordan to *Orchopeas* (1933). The typical *Orchopeas sexdentatus sexdentatus* Bak. 1904 was described from *Neotoma,* California. *Neotoma* is the true host for all races of this species. The species is very widely distributed both in Canada, and generally in N. America and forms several races. *O. sexd. agilis* was described from Alberta, Can. Nat. Park and B. C. The difference in the number of spiniforms on the endopodite, which Rothschild took as a character distinguishing *agilis* from *sexdentatus,* is in reality not a peculiarity of *agilis,* but an individual variation, this number being different in specimens collected from one and the same *Neotoma.* In B. C. *O. sexd. agilis* is very common. Spencer's and Kamloops collection contain many specimens from *Neotoma cinerea occidentalis* collected in different localities (Vavenby, Rutland, Haneville, Nicola, Salmon Arm etc.), as well as single specimens occasionally taken from *Ochotona princeps* and from *Mustela suturata.*

*23. *Orchopeas caedens durus* Jord. 1929. This form from B. C. Jordan separates from another one described by him earlier, *O. caedens caedens* 1925 from Alberta. As this species varies considerably and lives on the widely distributed *Sciurus hudsonicus* (as well as on *Sciurus duglasii* and *S. richardsoni*), I doubt that there exist two different races in two neighbouring provinces (Alberta and B. C.). Possibly we have to do here not with races, but with simple non-geographical variations. The question also remains open as to whether *O. caedens* Jord. does not possibly represent the same species which was insufficiently described by Baker under the name of *O. labiatus* Bak. 1904 from *Lynx canadensis.* Occasionally *O. caedens* occurs on *Mustela.* In the collection there are several specimens from *Sciurus hudsonicus streatoris* from different localities in B. C. and further 1 ♀ from *S. duglasii cascadensis,* 1 ♀ from *Eutamias amoenus* (obviously by chance) and 1 ♀ from *Mustela suturata.*

24. *Orchopeas nepos* Roths. 1905. Was described from 1 ♂ and 1 ♀ from *Spilogale latifrons* from Chilliwack, B. C. There is no other information in the literature, but my collection contains 1 ♂ 2 ♀ ♀ from Abbotsford B. C. from *Sciurus* sp. Very likely *Sciurus* is its proper host. In the East *O. nepos* is replaced by another species. (*O. wickhami* Bak.).

25. *Tarsopsylla coloradensis* Bak. 1895. A vicariating species which replaces *T. octodecimdentatus* of the Old World and lives like the latter, on squirrels. Described from *Sciurus fremonti,* Colorado. It is as yet not indicated from B. C., but to judge by its near relation in the Old World, I think it must be as widely distributed in N. America, extends its area northward from Colorado and is to be met with in the Rocky Mountains.

*26. *Monopsyllus vison* Bak. 1904*). Among the American species *M. vison* is seemingly the nearest to the type of the genus (*M. sciurorum* Schr.) and replaces in America this European-Asiatic species, typical for the squirrel of the

*). The restoration of Kolenati's genus *Monopsyllus* (1857) by Jordan cannot be accepted without some objections, which are expressed in the paper by Wagner and Argyropulo, Aphanipterenfauna der Aserbeidschan, Zeitsch. f. Parasitenkunde, VII, 1934. The extent which Jordan gives to this genus seems to me hardly natural.

Old World (*Sciurus vulgaris*). In N. America *M. vison* lives also on squirrels and is encountered on other Mammals only by chance. It is widely distributed from far west to far east. For B. C. it was indicated by Jordan. Spencer's and the Kamloops collection contain specimens from B. C. collected on *Sciurus hudsonicus streatoris* (Nicola Ranges, Riske Creek, Chilcotin, Rutland, Fish Lake, Pass Lake, Black Pines and Green Lake Mt.) and occasionally (1 ♀) on *Putorius arizonensis* (Monte Creek).

*27. *Monopsyllus eumolpi* Roths. 1905. In B. C. and Alberta—a typical parasite of Chipmunks, on which it replaces the North-Asiatic species, *M. tamias* Wagn., although it sharply differs from the latter. It is unknown how far it extends eastward. In the United States it is known from Montana and Arizona. Spencer's and Kamloops collection contain many specimens from *Eutamias amoenus affinis* from Stump Lake, Pass Lake, Black Pines, Kamloops, Cold Creek, Nicola, Green Lake Mt. and 1 ♂ from a squirrel from Rutland.

*28. *Monopsyllus ciliatus protinus* Jord. 1929. Like the former lives also on Chipmunks, but on another species. The typical *M. ciliatus ciliatus* Bak. 1904 was described from California collected on *Eutamias townsendi; M. ciliatus protinus* was indicated by Jordan from B. C. on the same species *Eutamias*. Less frequently it is encountered on squirrels. Spencer's collection and the collection of Kamloops contain several specimens from *Eutamias townsendi cooperi* and from *Sciurus douglasii cascadensis* (Gambier Is., Joco, Vancouver).

*29. *Monopsyllus wagneri wagneri* Bak. 1904. Described from *Peromyscus leucopus* from Idaho. *Peromyscus* is its true host; on other mice and on weasel it is encountered only by chance. Besides Idaho it is indicated from the western part of Montana, and in Canada from B. C. It is in general a western species, but in the Berlin Museum there is 1 ♀ described under the name of *M. bakeri* Wagn. (1933), which was collected from a house mouse at Labrador and possibly represents a race of *M. wagneri*. According to Jordan there lives another race in Alberta, *M. wagneri systolus* Jord 1929 (on *Peromyscus arcticus*). Spencer's collection contains specimens collected on *Peromyscus* from Aspen Grove, B. C. and 1 ♀ on *Putorius arizonensis* from Monte Creek.

*30. *Ceratophyllus niger* Fox 1908. Vicariating species living in the western area of N. America, especially frequent in seaside districts. On birds it replaces a very closely allied species of the Old World—*C. gallinae* Schr. The latter came with Europeans to America, but to the East, and as yet is not found westward of the Rocky Mountains. An interesting case of a meeting of the indigenous form (*C. niger*) with its nearest relation from the East (*C. gallinae*) in the central part of the N. American continent. For the first time Fox secured *C. niger* in S. Francisco from a man and a rat, and later on (1909) from the nest of a sparrow, which bird he took for the true host of the flea. At last *C. niger* was found to be common on hens (California, British Columbia). Was indicated from *Planesticus migratorius* (Br. Columbia) and *Meleagris gallopavo* (Alberta). I think therefore it will be found in the nests of many American birds. It wanders to mammals only occasionally. Jordan described 1 ♀ from Colorado collected on an unknown host and 1 ♀ on *Eutamias*, as a particular race, *C. niger inflexus* (1929) but I possess specimens from Abbotsford, B. C., from one and the

same hen-house both of typical *C. niger* as well as *C. nig. inflexus;* however the sinus on the 7th sternite shows a different degree of sharpness, so I believe that *inflexus* is not a race, but a simple variation. Spencer's collection contains 1 ♂ from *Acridotheres cristatellus,* brought from Japan.

31. *Ceratophyllus diffinis* Jord. 1925. A northern species widely distributed in Canada and Northern states on different birds. In British Columbia indicated from *Columbus griseigenea holboelli* (Okanagan Falls).

32. *Ceratophyllus celsus* Jord. 1926, described from *Riparia riparia,* Okanagan Falls, B. C.

33. *Ceratophyllus idius* Jord. and Roths. 1920. Described from nests of *Iridoprocne bicolor,* British Columbia (Okanagan Landing). Indicated also from Massachusetts in nests of *Sialis sialis* and *Troglodytes aedon.*

34. *Cerotophyllus riparius* Jord. and Roths. 1920. A species very close to the European species, *C. styx* Roths., living, like the latter, in nests of *Riparia riparia.* First described from Wisconsin (Milwaukee) and Virginia (Rosslyn), and later on indicated from the state of New York (Ithaca) and British Columbia (Okanagan Falls).

35. *Ceratophyllus adustus* Jord. 1929. Described from 1 ♀ from *Erethizon epixanthum,**) Atlin, British Columbia.

*36. *Dasypsyllus gallinulae perpinnatus* Bak. 1905. Like the European race *D. gall. gallinulae* Dale, 1878, lives on very different birds. Spencer's collection contains specimens from different places in B. C. collected on *Cyonocitta stelleri, Hedymeles melanocephalus capitalis, Hylocichla guttata, Hyl. ustulata, Junco oreganus schufeldtii, Lanivires solitarius cassini, Papilio maculatus oregonus, Penthestes atricapillis occidentalis* and *Piranega ludoviciana;* by chance 1 ♂ on *Sciurus douglasii cascadensis.*

*37. *Megabothris abantis* Roths. 1905. Replaces in B. C. and Alberta the northern european-asiatic species *M. rectangulatus* Wahlgr. 1903. Was described from *Microtus drumondi* and (by chance) from *Putorius longicaudatus.* Collection of Kamloops contains specimens collected on *Sciurus hudsonicus* from Rutland, on *Putorius arizonensis* from Monte Creek and on some unknown rodent from Green Lake Mt. I possess this species from Abbotsford, B. C., collected on *Microtus townsendi* and on *M. oregoni serpens.* It is probable that different species of Microtinae are its usual hosts.

38. *Megabothris quirini* Roths. 1905. A species widely distributed in Canada on Microtinae. From B. C. (Atlin) it was indicated (1 ♀) on *Microtus drummondi* (Jordan).

39. *Megabothris atrox* Jord. 1925. Although this species was described as living in Alberta (Blackfalds) on *Mustela* (doubtless by chance), yet, if this species be, as Jordan presumes (which I doubt), a bird-flea, it must also be found in British Columbia.

*. 40. *Megabothris asio* Bak. 1904. A pretty rare species, but widely dis-

*). There is no doubt that the number of bird fleas of the genus *Ceratophyllus,* encountered in B. C. must be far greater than cited, here because bird fleas, particularly those which live not on one but on different species of birds or on migratory birds are characterised by a wide distribution; until now insufficient attention has been paid to the collection of fleas from birds nests in British Columbia.

tributed in the Northern States. Very near to the east-asiatic *M. calcarifer* Wagn. Lives, as it seems, like *M. calcarifer,* on mice Spencer's collection contains ♂ from a "mouse nest," Salmon Arm, B. C. (21. IV. 32).

41. *Megabothris megacolpus* Jord. 1929. Known only from 1 ♀, collected on *Microtus drummondi* from Okanagan Landing, B. C.

42. *Malaraeus telchinum* Roths. 1905. With the exception of one circumpolar species (*M. penicilliger* Gr., s.b.), all species of *Malaraeus* live in the western region of North America. *M. telchinum* was described from B. C. (Kicking Horse Canyon), collected on *Evotomys gapperi* and *Sorex richardsoni;* later on it was found in the state of Montana on *Peromyscus maniculatus* and in single specimens on *Microtus mordax* and *Sylvilagus nuttali* (on the latter obviously by chance); Carrol Fox got it from California collected on *Microtus californicus.* As it seems Microtinae are its usual hosts.

43. *Malaraeus euphorbi* Roths. 1905. On *Peromyscus canadensis* from Horse Creek, B. C.

44. *Malaraeus bitterrootensis* Dunn and Parker 1923. Described from *Neotoma cinerea* from Montana and later on indicated from the Rocky Mountains (Red Deer), B. C. It appears to be as widely distributed in the West as *M. telchinum.*

45. *Malaraeus penicilliger* Gr. 1851. A circumpolar species. Described first from Siberia. (Turuchansk, near to the polar circle). Later on its wide distribution over all North Asia and Europe was stated; in southern countries dwells almost exclusively in mountains. Was found in the North of B. C. Usual hosts of the species—different species of *Microtinae;* in North America also—*Peromyscus.*

Subfam. Neopsyllinae Oudem

46. *Neopsylla wenmanni* Roths. 1904. The genus *Neopsylla,* rich in species, is common in Asia and N. America. Out of 15 Asiatic species only 3 extend to the far east of Europe. From N. America there are known 8 species, of which *N. wenmanni,* according to the existing information, is the most widely distributed. Lives in preference on *Peromyscus.* Described first from B. C. (on *Peromyscus leucopus* and *Neotoma cinerea*), but has also been found in Alberta, Montana, Utah, Arizona, New Mexico, and in the East in New Brunswick, Massachusetts, New York and Maryland.

47. *Neopsylla inopina* Roths. 1915. Lives on *Citellus* and was described on *C. columbianus* from Calgary (Alberta). Therefore it is probable that it will be also encountered in B. C. Besides Alberta, has been found in Montana.

*48. *Neopsylla grandis* Roth. 1902. Probably a synonym of *Pulex gigas* Bak. 1895 (*nec gigas* Kirby!), from Michigan. Was described from Ontario Canada by Rothschild on *Tamias striatus.* Spencer's collection contains from the same host 2 ♀ ♀ which I believe to be of the same species, from Quebec (Lennoxville). Was also indicated from eastern America from the state of New York and the Adirondacks, also on *Tamias striatus.* Considering the wide distribution of *Tamias striatus,* one can suppose that this rare species of *Neopsylla* will be found also in B. C.

*49. *Catallagia charlottensis* Bak. 1898. An exclusively North Ameri-

can and by preference western genus, living on Microtinae (*Microtus, Peromyscus* and others), near to *Neopsylla. C. charlottensis* was described from Massett, Queen Charlotte Islands. In B. C. has been found at Inverness on *Peromyscus macrochirus.* Collection of Kamloops contains 1 ♀ from *Citellus columbianus* (obviously a casual host), Vavenby (7.VII.32).

*50. *Catallagia decipiens* Roths. 1915. Described from B. C. (Horse Creek) and Alberta (Blackfalds, Red Deer) on *Peromyscus leucopus, P. arcticus, Evotomys suturatus* and *Neotoma cinerea.* Probable host—*Peromyscus.* Collection of Kamloops contains 1 ♂ and 1 ♀ collected on *Citellus columbianus* (Vavenby, 27. IV. 32) and *Eutamias amoenus* (Jamieson Ck., 27. VII. 32).

51. *Catallagia telegoni* Roths. 1905. Described on *Microtus drummondi* and *Evotomys gapperi* from B. C. (Horse Creek) and Alberta (Kicking Horse Canyon).

Subfam. Rhadinopsyllinae Wagn.

*52. *Rectofrontia sectilis* J. and R. 1923. Of the genus *Rectofrontia,* which is distinguished by me from *Rhadinopsylla,**) 9 species live in Asia, 6 in Europe and 2 have been described from North America. American species are little known. *R. sectilis* is known only by 3 ♀ ♀ found in B. C. (Kelowna) on *Peromyscus* sp. and *Mus.* sp. Spencer's collection contains specimens from *Peromyscus maniculatus austreus* labelled "University of B. C., Vancouver, 8.11.28," which, as it seems, belong to this species, to judge by the description of Jordan and Rothschild and following the indication of Jordan, that in this species the metepisternum is fused with metanotum, but the genal ctenidium consists of 5 spines (in one on one side, 6 spines), whereas the sternites in ♀ have not 7-8, but 6 bristles. The form of the 7th sternite and recept. seminis fully corresponds to the drawing in the paper by Jordan and Rothschild. Consequently, taking the specimens of Spencer's collection for *R. sectilis,* I think the normal number of spines of genal comb in *R. sectilis* to be 5 or 4, seldom 6. From the other North American species, *R. fraternus* Bak. **), females are easily distinguished by the recep. seminis, which has a distinct hollow on the appendix (tail), absent in *R. fraternus.* The longest apical bristle of hindtarsal segment 2. reaches by its end maximum the middle of the 4. segment. Differs from ♂ *R. fraternus* in that the 8th sternite possesses on each side 3 bristles, a weak acetabular bristle is fastened beneath the endopodite. Notch on the anterior margin of the endopodite situated near its apex. The male not being described I give a drawing of its genitalia as well as of the genal comb, both of the male and the female. (Figs. 8 and 9).

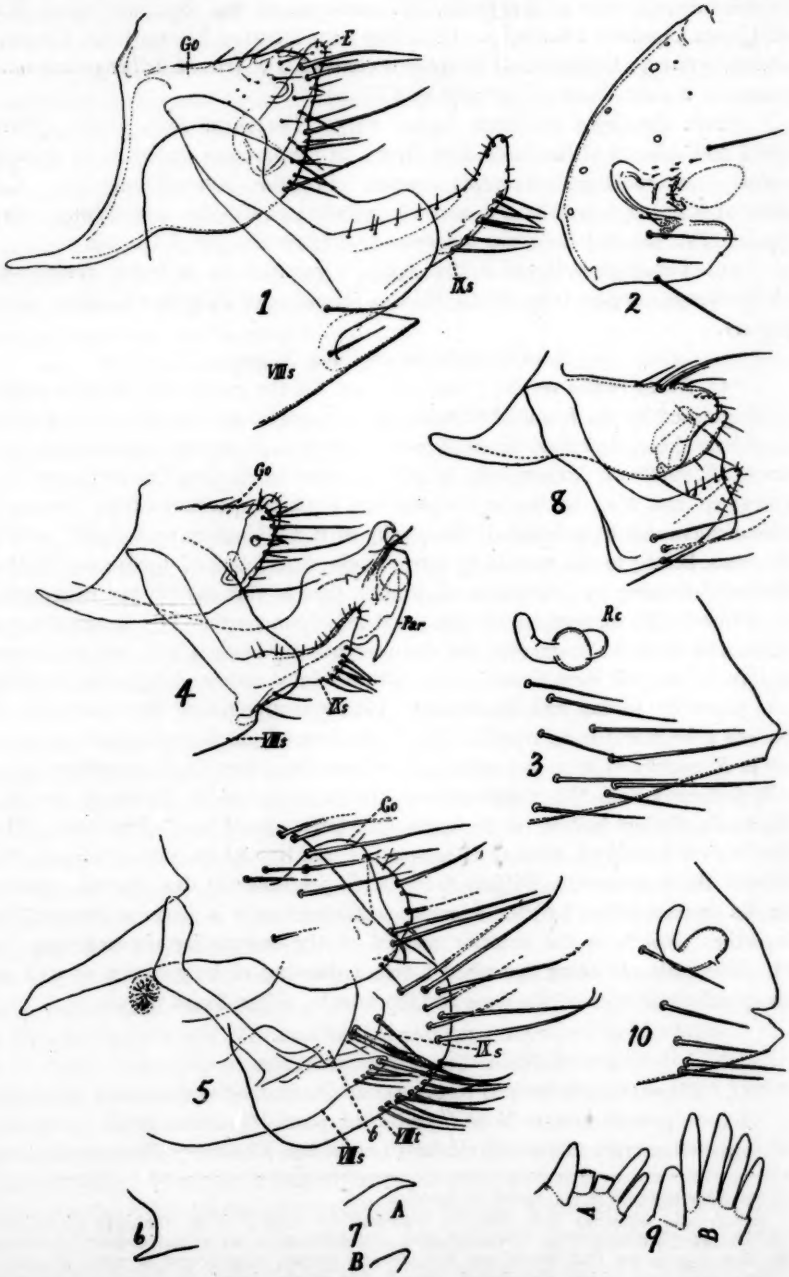
FAM. CTENOPSYLLIDAE BAK.

Subfam. Ctenopsyllinae Wagn.

53. *Nearctopsylla brooksi* Roths. 1904. According to the scanty information which we possess to date *Nearctopsylla* is a purely Canadian genus. According to some characters this genus reminds one of the Rhadinopsyllinae, according

*) True *Rhadinopsylla* is not found in America.

**) *Rectofrontia fraternus* Bak. 1895, is described too briefly from Michigan (Lansing) and S. Dakota (Brookings) on "common garden mole" and on an unknown host. In view of the fact that in the Old World the *Rectofrontia* species, encountered in nests of moles and shrew-mice, are widely distributed, though but rarely found, one can suppose that *R. fraternus* will be found also in B. C.



THE FLEAS OF BRITISH COLUMBIA

to others of the Ctenopsyllinae. The proper hosts of the genus are unknown. *N. brooksi* is found in B. C. (Neresall and Mabel Lake) and Alberta (Calgary) on *Putorius richardsoni, P. longicaudatus* and *Mustela americana.*

54. *Nearctopsylla hyrtaci* Roths. 1904. Found on *Putorius energymenas* and *Sorex obscurus* at Cariboo, B. C. True host, unknown (perhaps *Sorex*).

55. *Nearctopsylla hygini* Roths. 1904. Probably is to be encountered in B. C., although described from Alberta (Red Deer) on *Putorius richardsoni* and the subsp. *laurentia* Jord. and Roths., 1923 from New Brunswick on *Mustela* sp.

56. *Ctenopsylla selenis* Roths. 1906. Described from Horse Creek, Upper Columbia Valley, B. C. on *Peromyscus canadianus* and *Microtus drummondi,* from Kicking Horse Canyon on *Evotomys gapperi* and from Alberta on *Evotomys gapperi* and Kangaroo mouse. According to Stewart it is also encountered on *Peromyscus maniculatus.*

*57. *Ctenopsyllus rawailliensis* Dunn and Park. 1923. Described on *Neotoma cinerea* from Montana (south westwards from Darby). From the same host, *Neot. cinerea occidentalis* there is in the collection of Kamloops 1 ♀ from Vavenby, B. C. (31.VII.32), which like *C. rawalliensis* has 4 spiniforms (spine-like bristles) near the angle of the frons on each side and 4 antepygidial bristles (on the right side, on the left—but 3). As Dunn and Parker do not give a description either of the 7th sternite or of the recept. seminis, I give here a drawing of these parts, so important for the determination, from the specimen in the Kamloops collection (Fig. 10).

*58. *Corrodopsylla curvata* Roths. 1915. Described from the state of Iowa on *Blarina brevicaudata* and from Alberta (Blackfalds) on Kangaroo mouse and *Sorex* sp. Indicated later from the Adirondacks on *Blarina brevicaudata.* Collection of Kamloops Laboratory contains 1 ♂ from *Sorex,* Kamloops, B.C. (11. VIII. 29), and in my collection there are—2 ♀ ♀, *C. curvata* subsp. *obtusata* from *Sorex* sp., Abbotsford (27.III.28). It is interesting to note that another species of this genus, *C. birulai* Ioff. was found in the Transbaikal district (near Tchita) on *Rattus norwegicus caraco* (obviously by chance), in the vicinity of Briansk (European Russia) on *Neomys fodiens* and in Lappland on *Neomys fodiens, Sorex araneus, Microtus ratticeps* and *Evotomys rutilus.* As it seems, these two species *C. curvata* and *C. birulai,* replace one another in the New and Old World.

Subfam. Hystrichopsyllinae Tirab.

*59. *Hystrichopsylla dippiei* Roths. 1902. It is very possible that *H. dippiei* will appear as a synonym of *Pulex gigas* Kirby, 1837, (*nec* Baker!). Rothschild received this species from B. C., collected on *Lutreola energamos* (Chilliwack) and from Alberta on *Putorius longicaudatus.* Both hosts are but accidental. As proper hosts must be considered different small *Glires* of the Fam. Muridae and Insectivora. The Berlin Museum possesses 1 ♀ from Vancouver, B. C., collected on *Peromyscus eusterugus.* The species is widely distributed but rarely encountered. Besides from Canada it is indicated from the Adirondacks on *Blarina brevicaudata* and on *Microtus pensylvanicus,* from the state of New York on *Peromyscus leucopus noveboracensis,* from Montana on *Eutamias luteiventris* and *Sciurus hudsonicus.* Spencer's collection from B. C. contains single

specimens from different localities, collected on *Sorex* sp., *Spilogale phenax* and *Eutamias amoenus affinis.*

60. *Atyphloceras artius* Jord. 1933. Exclusively a North American species, near to *Typhloceras* of the Old World. Out of 5 species, known to date, only one has been described, based on 1 ♀, from B. C. (Kelowna), collected on *Peromyscus* sp.

ISCHNOPSYLLIDAE WAHLGR.*)

61. *Myodopsylla gentilis* J. and R. 1921. Described from Landing, B. C. collected on "a bat."

*62. *Rhinolophopsylla palposus* Roths. 1904. Described as *"Ceratopsylla" palposus* from Cowicham Demeaus, B. C., collected on a "brown bat," two ♀ ♀. It must be considered either as a species of the genus *Rhinolophopsylla,* which in the Old World is characteristic for *Rhinolophus,* or as a species of a separate genus near to *Ischnopsyllus.* Male not described. Spencer's collection contains ♀ from Vancouver, B. C., collected on *Eptesicus fuscus fuscus* (25. VIII. 31).

Out of 62 species indicated in the present list 9 have not as yet been found in British Columbia, but according to my opinion, should be encountered there. The collection contains 29 species from B. C., of which 12, which are noted by a star (*), had not previously been reported from this country and 4 species are new (*Megarthroglossus similis, M. spenceri, M. pygmaeus* and *Thrassis spenceri*). To judge by this collection the aphanipterological fauna of British Columbia is far from being exhausted by the present list.

LITERATURE RELATING TO THE FLEAS OF BRITISH COLUMBIA.

Baker, Preliminary studies in Siphonaptera. Canad. Entom., XXVII, 1895.
Pulex keeni sp. n. from Queen Charlotte Islands. Ibid., XXVIII, 1896.
Notes on Siphonaptera with descriptions of four new species. Journ. N. York. Ent. Soc., VI, 1898.
A revision of American Siphonaptera or Fleas. Proc. U. S. Nation. Mus., XXVII, 1904.
The classification of the American Siphonaptera. Ibidem, XXIX, 1905.
Dunn and Parker, Fleas found on wild animals in the Bitterroot Valley, Montana. Publ. Health Repts., Washington, XXXVIII, 1923.
Ewing, Notes on the taxonomy and natural relationships of fleas, with descriptions of four new species. Parasittol, Cambridge, XVI, 1924.
Notes on the Siphonapteran Genus Doratopsylla J. and R. together with a description of a new Genus and Species of Fleas. Journ. of Parasitol., XII, 1925.
Notes on the Siphonapteran Genus Catallagia Rothschild. Proc. Biol. Soc. Washington, XLII, 1929.
Fox (*Carroll*), Ceratophyllus niger n. sp. Entom. News, XIX, 1908.
A Report on the Species of the Siphonaptera found within the Boundaries of the city and country of San Francisco. Ibidem, XX, 1909.
Some new Siphonoptera. Bull. 97 hyg. Lab. publ. Health Mar.-Hosp. Serv, 1914.
The taxonomic value of the copulatory organs of the females in the order Siphonaptera. Ibid., 1914.
Jordan, New Siphonaptera. Novit Zool. XXXII, 1925.
New Siphonaptera. Ibidem, XXXIII, 1926.
Siphonaptera collected during a visit to the Eastern Un. States of N. America in 1927, Ibidem, XXXIV, 1927.
Notes on North American Fleas. Ibid., XXXV, 1929.
Further records of North American Bird-Fleas. Ibid.
On a small collection of Siphonaptera from the Adirondacks. Ibidem.
On some problems of distribution, variability and variation in North American Siphonaptera. Trans. 4. Intern. Congr. of Entomol., Ithaca, II, 1929.

*) There is no doubt, that several species of this family, occur in B. C., but scarcely any collections of fleas from bats, the specific hosts of this family, have been made in this province which explains the fact that up to date only two species are recorded.

The Siphonaptera collected by Mr. Harry S. Swarth at Atlin in British Columbia. Novit. Zool., XXXVIII, 1932.
Two new American species of Siphonaptera. The Entomolog., London, LXVI, 1933.
Descriptions of Siphonaptera. Novit. Zool., XXXIX, 1933.
A survey of the classification of the American species of Ceratophyllus s. lat. Ibidem.

Jordan and Rothschild, On the genus Amphipsylla Wagn. The Zoologist, No. 869, 1913.
Contribution to our knowledge of American Siphonaptera. Ectoparasites, I, 1915.
On American Bird-Ceratophylli. Ibid., 1920.
New genera and species of Rat-Fleas. Ibid., 1921.
New Siphonaptera. Ibid., 1922.
New American Siphonaptera. Ibid., 1923.

Rothschild, Some new Nearctic Fleas. Entom. Rec., XIV, 1902.
Further contributions to the knowledge of the Siphonaptera. Novit. Zool., X, 1903.
Further contribution to the knowledge of the Siphonaptera. Ibid., XI, 1904.
On North American Ceratophyllus, a genus of Siphonaptera. Ibid., XII, 1905.
Three new Canadian Fleas. Canad. Entom., XXXVIII, 1906.
On some American, Australian and Palearctic Siphonaptera. Novit. Zool., XVI, 1909.
Further note on Siphonaptera fracticipita. Ectoparatites, I, 1915.
On Neopsylla and some allied genera of Siphonaptera, Ibid., 1915.

Wagner, Ueber die nordamerikanischen Ceratophylli, welche auf Zieseln und Murmeltieren leben. Konowia, VIII, 1929.
Notiz uber Doratopsylla curvata Roths. und D. birulai Ioff. Ibidem.
Key to the species of Aphaniptera, which live on Muridae. Magaz. de Parasitol., Lenigrad, 1930.

EXPLANATION OF PLATE II.

Fig. 1. *Megarthroglossus similis* sp. n. ♂. Genitalia. Go= gonopode, E= endopodite, s= sternite. Fig. 2. *Megarthroglossus spenceri* sp. n. ♀. Head. Fig. 3. *Megarthroglossus spenceri* sp. n. ♀ Sternite VII. and receptaculum seminis (Rc). Fig. 4. *Megarthroglossus pygmaeus* sp. n. ♂ Genitalia. Go= gonopode, Par=paramere, s= sternite. Fig. 5. *Thrassis spenceri* sp. n. ♂. Genitalia. Go= gonopode, b= basis of the chitinous apparatus of penis, s= sternite, t= tergite. Fig. 6. *Thrassis acamantis* Roths. ♂. Basal ventral angle of the chitinous apparatus of penis. Fig. 7. *Thrassis spenceri* sp. n. ♂ (A) and *Thr. acamantis* Roths. ♂ (B). End of the paramere. Fig. 8. *Rectofrontia sectilis* J. and R. ♂ Genitalia. Fig. 9. *Rectofrontia sectilis* J. and R. Genal comb of ♂ (A) and of ♀ (B). Fig. 10. *Ctenopsyllus ravalliensis* Dunn and Park. ♀. Sternite VII and recptac. seminis.

FURTHER NOTES ON THE GENUS AMELETUS WITH DESCRIPTIONS OF NEW SPECIES.* (EPHEM.).

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The work of my assistant, Mr. A. N. Gartrell, in southern British Columbia during the season of 1935 has resulted in considerable additions to our knowledge of the genus *Ameletus* in this province; not only have the nymphs of *A. oregonensis* McD. and *vernalis* McD. been tied down, but two new species have been discovered.

It is proposed to deal with these in the present article but before doing so it might be well to call attention to an error which has crept into Traver's key to the adults (1935, Biology of Mayflies, 447); in this key the first caption reads "Several cross-veins in forewing margined with brown, so that wing appears speckled" and under this heading is included as first species *validus* McD. This is incorrect as the wings of *validus* are *not speckled* but lightly and evenly suffused with brownish-amber, and the species, if properly keyed, would fall into caption 6, where it is distinguished from *shepardi* Trav. apparently by the darker-colored abdominal segments. *Similior* McD., as second species under caption 1, is also wrongly keyed; in this species the wings are practically clear hyaline and the

*Contribution from the Division of Systematic Entomology, Entomological Branch, Department of Agriculture, Ottawa.

correct keying would lead to caption 13 (*alticolus* McD.) to which species it is allied but differs in genitalic characters.

Ameletus oregonensis McD.

Nymph. 10-12 mm. Head brown with pale mouth-parts; a triangular pale area between the antennae and pale shading laterad and cephalad of the two posterior ocelli; a faint pale medio-dorsal line, broadening near vertex into a small rectangular patch. Antennae with brown basal joint; remainder with alternating broad bands of pale and light brown, presenting a distinctly ringed appearance. Thorax light brown, shaded with pale; scutellum pale with *two prominent oval brown spots,* one on each side of the median line. Abdomen light brown with broad deep brown median patches, and a narrow deep brown posterior border projecting forward laterally beneath the gills. On segments I-V and X there are rather indistinct pale subdorsal spots bordering the median dorsal patches above referred to and tending on V to coalesce across postero-dorsal portion of segment; the lateral edge is pale, except in posterior corner; segments VI and VII are largely brown, but on VIII and IX the pale areas are more extended, consisting of large white spots subdorsally and near posterior margin, lateral oblique bands, terminating in a round spot on anterior margin and the quite distinct pale lateral edge; there is considerable tendency for the pale areas of each side not only to coalesce among themselves, but also to coalesce across the posterior portion of the segment. Ventrally pale brown with no ganglionic marks nor any distinct pattern. Well marked individuals show pale lateral streaks and a row of four small equidistant pale dots across anterior margin of segments VI-IX, the anterior segments showing only faintly the outer pair of these. Tails brown at base and then very *characteristically banded alternately with pale and dark brown,* except the extreme tips which are whitish. Gills pale, with poorly defined tracheation, a *dark brown interior band of chitin* much as in *velox* Dodds and the ventral margin broadly but rather indistinctly thickened with chitin. Legs with basal area of femur pale; a broad deep brown median band and apical section shaded more or less with lighter brown, especially on fore-femora. Tibiae and tarsi with basal half pale, apical section brown, claw brown.

There is considerable variation in the pattern of the abdominal segments according to the amount of coalescing between the white spots both on anterior and posterior segments, but segments VI and VII usually remain brown; the very characteristic color of the tails should render the nymphs readily recognizable.

Ameletus vernalis McD.

Nymph. Male. 9-10 mm. Head brown, shading into gray-brown above antennae; mouth parts largely pale; a pale area between the antennae and in medio-dorsal line before vertex; antennae pale, with single dark band beyond middle. Thorax light brown, strongly marked with pale streaks and dashes; scutellum pale. Abdomen with segment II dorsally largely pale with two oval brown patches bordering the mediodorsal line anteriorly and a small lateral dark spot below the gill; segments III-V brown with very obscure paler maculation consisting (as far as can be determined) of a rather large oval median spot and two subdorsal semioval spots on each side; of these the posterior one is smaller

and more distinct; the lateral edge is clear whitish except at posterior corner and there is a fairly clear round whitish spot adjoining the gill in anterior section. On VI the pale lateral areas are considerably extending leaving a large, roughly quadrangular brown patch dorsally and a comma-like dash attached to the anterior margin laterally, the postero-lateral angle being dark as in the preceding segments. Segment VII shows still further reduction of the dark areas and is much as segment II but with rather larger dark dorsal patches. Segment VIII is pale with narrow dark anterior and posterior borders, two small oval subdorsal brown spots more or less connected with posterior dark border and occasionally, but not constantly, a narrow oblique dark band connecting the lateral comma-mark with the posterior border. Segment IX *brown* with *two small pale triangular lateral spots* attached to anterior margin; segment X with anterior dark and posterior pale halves and a narrow medio-dorsal dark band. Ventrally pale brown with broadly pale lateral edge except on segment IX and the usual small pale dot near antero-lateral corner. Tails pale, whitish, broadly banded with brown just beyond middle and with the extreme tips brown. Gills pale with faint tracheation, an interior dark band just within the dorsal margin, much as in *alticolus* McD. and faint traces of chitinous thickening along ventral edge. Legs pale; femora with large brown median patch on outer side; tibiae entirely pale, except at extreme base; tarsi with brown bands both basally and apically; claw pale brownish.

In the female nymphs there is a tendency towards diffusion of the maculation.

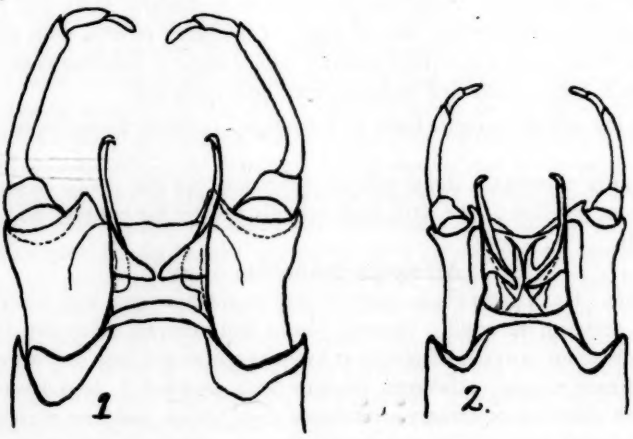
Occurs apparently along with the preceding but can easily be separated by the different position of the dark band on gills and by the entirely different color of the tails.

Ameletus connectus n. sp.

Male. Head pitch-black, paler at base of antennae and with a small yellowish patch posterior to ocelli. Thorax, pleura and sternum shiny pitch-black, the more membranous portions of pleura at bases of wings and legs dull brownish with slight ochreous tinges. Abdomen dorsally with segment I deep brown, II-VII semihyaline ochreous or creamy with broad deep brown posterior margin, slightly paler mid-dorsal brown band and lateral brown triangles based on the posterior margin; VIII-X more opaque with slight increase of brown-shaded areas; trachaea forming dark network over paler portions. Ventrally pale ochreous without ganglionic marks. Forelegs deep pitch, faintly paler at base of femur; mid- and hind-legs somewhat paler, femora tinged with purplish and tibiae and tarsi of a deep dirty amber color. Wings hyaline with fine dark brown longitudinal veining; crossveins fine, light brown, uncolored and almost invisible in costal area except in pterostigmatic space where they are brown and evenly anastomosed, forming a row of small marginal cells based on a second row of much larger ones. In the genitalia the penes-lobes are long, parallel and strongly bent dorsad at apex; stimuli are lacking. The posterior margin of the forceps-plate between the two tubercles is straight and without the V-shaped excavation frequently found. Length of body 12 mm.; of forewing 12 mm.

Nymph. If the single nymphal skin before me has been correctly associated the nymph is very similar in maculation to that of *vernalis* McD., but apart from

larger size the pale spotting is more indistinct and the brown areas more extended; segments V and VI and IX are almost unicolorous dark brown; on segments VII and VIII the brown areas have increased in size, leaving a large diamond-shaped dorsal patch and an irregular, oblique lateral band of the pale color; on X the whole dorsal area is broadly brown with a narrow oblique lateral pale stripe. The tails are similar marked to those of *vernalis* but the dark band is broader and starts closer to the bases of the tails. In the gills the interior dark band is still closer to the dorsal margin than in *vernalis* and the chitinous thickening of the ventral edge much heavier; the tracheation is also slightly better defined but still improminent. The femora are pale with a large rectangular brown patch in median area, small brown areas at base and apex and a brown streak extending back from apex along dorsal edge, the tibiae are slightly tinged with brown at base and the tarsi are broadly ringed with black-brown at both base and apex. Ventrally the abdomen shows no distinct maculation except the pale lateral edge and the usual white dots situated in the anterior-lateral region.



Male Genitalia of 1. *Ameletus connectus* n. sp.; 2. *Ameletus suffusus* n. sp.

Holotype.— ♂, Shingle Cr. Penticton, B. C., May 5, 1935, (A. N. Gartrell); bred from nymph (B 1075); No. 4109 in the Canadian National Collection, Ottawa.

The species seems to connect the *velox* and *validus* groups, the nymph showing affinities in abdominal and femoral maculation with the latter group whilst the genitalia are distinctly reminiscent of the former.

Ameletus suffusus n. sp.

Male. Head and thorax shiny blackish, the mesothorax with scutellum shaded with brown and preceded by two orange-yellow streaks; a similarly colored lateral streak below anterior section of mesothorax and the membranous portions of pleura at bases of wings and legs considerably shaded with light brownish. Abdomen dorsally with segment I blackish and other segments rather bright yel-

low, broadly bordered with brown posteriorly and slightly brown-shaded along lateral edge where the tracheation shows as a fine dark network; segments VIII-X opaque with brown suffusion rather more extended than on the preceding semi-hyaline segments. Ventrally dull pale ochreous without ganglionic marks, segment IX and forceps-plate centrally tinged with yellow; forceps and lateral portions of forceps-plate deep brown. The genitalia are quite similar to those of *aequivocus* McD., but the penes-lobes are wider apart and the stimuli finer with apices directed outward. The forceps-plate is scarcely as broad in the present species. Tails smoky, faintly dark-ringed. Forelegs deep blackish, paling somewhat on tarsi; femora with slight purplish tinge. Mid- and hindlegs considerably paler, dirty amber, with traces of a ruddy patch at apices of femora. Wings *decidedly tinged with umber-brown,* paling somewhat outwardly; longitudinal veins rather bright brown, cross-veins more smoky brown; costal crossveins before bulla very numerous, in pterostigmatic area evenly anastomosed as in preceding species. Length of body 9 mm.; of forewing 10 mm.

Nymph. Male. From the nymphal skin of the holotype it is apparent that the maculation is essentially that of *validus* (1935, Can. Ent. LXVII, 102); on II the pale spots have spread and coalesced so that the dark area is confined to triangular patches on the anterior margin and a small lateral patch; on III and IV the maculation is well-defined; in V, VIII and IX the pale markings are reduced so that these segments appear largely brown; in VI and VII on the contrary the pale areas are extended by a coalescing of the subdorsal and antero-lateral spots, leaving a large, roughly triangular central area of the dark color; X is largely pale. Tails pale brownish at base and whitish terminally with a broad deep brown median band and similarly colored tips.

Ventrally on the first seven segments there is a broad dark broken medio-ventral band, tapering cephalad on each segment to a point and not quite attaining anterior margin, but broadening out in posterior half of segment, especially of V and VI, where it almost coalesces with a dark lateral stripe, extending down the segments slightly interior to the pale edge; VIII and IX largely brown with the exception of small white spots on the anterior margin. Gills pale, with indistinct tracheation and the *dorsal edge strongly chitinized.* Legs pale with dark central patch on femur and tarsus banded basally and apically with brown. Separable from *validus* by the dark segments VIII and IX and the much more defined ventral maculation.

In the skin of the paratype the white areas seem more extended but the segments V, VIII and IX still remain the darkest; the ventral maculation is not apparent but the specimen is poorly marked and apparently faded by too long immersion in water.

Holotype.— ♂, Shingle Creek, Penticton, B. C., May 3, 1935 (A. N. Gartrell), bred from nymph (B. 1066); No. 4110 in the Canadian National Collection, Ottawa.

Paratype.— ♂, same locality, June 30; bred (B. 1136).

OBITUARY

CHARLES E. GRANT

1850—1936

On March 8th, 1936, Mr. Charles E. Grant, one of the oldest members of the Society, passed away at Orillia, Ontario.

Charles E. Grant was born in Putney, London, on November 23rd, 1850. At the age of 6 he came to Canada with his parents because of the ill health of his father F. R. G. Grant, a solicitor at Lincoln's Inn, London. The family soon settled in Orillia, then a lumbering village. Here, Charles studied law and was in his father's office. In 1876 he was appointed town clerk for Orillia, an office which he held until he retired in 1929. In addition to his duties as town clerk he served as treasurer of the public school board for a period of ten years and as clerk of the police court for 25 years.

Mr. F. R. G. Grant, both before and after he came to Canada, was interested in Entomology. From him Charles acquired an interest in insects which gradually led him to become a tireless collector. Throughout the collecting season much of his leisure was spent in the open in the pursuit of specimens. Many of his evenings were spent on the verandah of his home where he had a powerful light to attract night flying insects. As a result of his constant interest he built up a collection of some 5,000 Lepidoptera, among which were many interesting forms preserved in a creditable manner.

For over 25 years Charles E. Grant was a director of the Society for the Orillia district and took a very keen interest in the Society and its welfare. This interest was maintained until the time of his death as shown by the fact that in his will he bequeathed his insect collection and cabinets to the Society where they have been deposited with the other collections of the Society in the keeping of the Department of Entomology of the Ontario Agricultural College.

BOOK NOTICES.

The Pioneer Century of American Entomology By Harry B. Weiss, New Brunswick, N. J. Published by the Author, Price $4.25, postpaid.

As stated by the author in his preface this work of 320 multigraphed pages actually deals with the pioneers of entomology in North America over a considerably greater period than a single century. Commencing in Chapter I with the scattered references to entomology found in the accounts of travelers of the late 16th to the early 18th centuries, and in Chapter II with the early books and papers published in the latter half of the 18th century, the author in Chapter III arrives at the early years of the 19th century and its workers. This is followed by most interesting chapters on Thomas Say and his contemporaries, Zimmermann and Le Conte, Fitch, Glover and Osten Sacken, concluding in Chapter VIII with the period centred about Walsh. Chapters IX and X deal respectively with the entomological periodicals before 1865 and with societies, exploring expeditions, etc. furthering the cause of entomology in America. Chapter XI, entitled "Some Notes on Canada," should be of particular interest to our Canadian readers and

entomological students, dealing as it does with Gosse, Couper, the founding and founders of the "Canadian Naturalist and Geologist" and the early years of the Entomological Society of Ontario, with frequent references to such well-known names as Saunders, Bethune, Bowles and many others. The work concludes with a short chapter on European contemporaries, a Bibliography and an Index.

The author's name is sufficient guarantee of the merit and accuracy of the work. It can be highly recommended not only to those entomologists who, with the author, have reached the age when "they begin to look backward," but also to the growing school of young entomologists who should be, but so often are not, conversant with the early history of entomology in North America. J. McD.

General Entomology, by R. A. Wardle, P. Blakiston's Son & Co., Inc. Philadelphia. 311 pages, 96 figures. $2.25.

This book, which deals largely with the basic principles of Entomology, should be admirably suited to the purpose for which it was written, "for students to whom the subject of Entomology represents merely one or two courses of the many that comprise their training for the profession of Zoology or Agriculture."

The first fifty-two pages, 2 chapters, deal quite thoroughly though briefly with insect anatomy, external and internal. In the third chapter, insect development and life cycle are discussed in a logical manner. Chapters four and five, 50 pages, deal with insect physiology and behaviour in sufficient detail to give the general student an appreciation of the functioning of the insect body and the reflexes constituting its behaviour. The last seven chapters, are devoted to the orders of insects, which are discussed in what the author considers to be their natural groupings. As well as keys to the suborders, super-families and families occuring in most of the orders; the pertinent facts concerning the commoner families and groups are included.

A Catalogue of Scientific Periodicals in the Maritime Provinces, prepared by Ernest Hess, Corresponding Secretary of the Nova Scotia Institute of Science and published by the Institute with the assistance of the National Research Council of Canada. Price $2.00.

This cloth bound catalogue of 82 pages is a comprehensive list of the scientific periodicals and government publications found in 26 maritime libraries. Some 3,500 publications are recorded in alphabetical order in a clear and concise form with no attempt to include bibliographical detail.

Although intended primarily as a reference book for research workers and librarians in the maritime Provinces, it forms a needed supplement to the "Catalogue of Scientific Periodicals in Canadian Libraries" published by McGill University in 1924. The catalogue lists only periodicals found in less than a quarter of the maritime libraries.

The reasonable price of this catalogue should make it available to individual workers as well as librarians. R. OZBURN.

NEWS AND VIEWS

BASIC RESEARCH IN THE UNITED STATES DEPARTMENT OF AGRICULTURE.

In the report of the Secretary of Agriculture of the United States for 1935 there are some thought promoting remarks made on the subject of scientific research in agriculture. On June 29th, 1935, the United States Congress passed an act which made special provision for basic research in the Department of Agriculture and in the Agricultural Experiment Stations and Landgrant Colleges. The measure, now known as the Bankhead-Jones Act, also provides for the further development of agricultural extension work. The act authorizes and directs the Secretary to "conduct scientific, technical, economic, and other research into laws and principles underlying basic problems of agriculture in its broadest aspects,—." In his report the Secretary points out that "Heretofore, the endowed scientific institutions such as the great foundations and some of the universities have been freer to conduct research of this character than have public agencies. Increased fundamental research in the Federal and State agencies is timely and in full accord with the principle that these public institutions should be prepared to keep our basic knowledge abreast of our need in meeting definite human problems."

"Entomologists, under the pressure of emergency demands, may try to discover the insecticide that will kill a particular moth and save a particular crop, and the effort may be worth while. It may be still more important, however, to reveal the habits and physiology of insects in general, so that the control problem can be dealt with broadly as it applies to many insect pests. Fundamental chemical research on the properties of insecticides may solve many insect-control problems simultaneously. Research for limited, so-called practical objects often fails, until scientists widen the scope of their inquiry to include the basic elements involved and so reveal the governing laws."

"The principle function of this Department is scientific research. All its other activities, such as weather and crop reporting, the eradication or control of plant and animal diseases and pests, the administration of regulatory laws, highway construction, and economic guidance, are practical expression of research results. Research is the primary thing, the keystone of the entire structure of the Department's functions and services. Naturally the Department does not rely exclusively on the findings of its own investigators; on the contrary, it draws upon the general fund of scientific knowledge as it increases throughout the world. But this is one of the tests of its scientific efficiency and value. Were the Department not engaged itself in creative scientific work, it could not use creatively the findings of other institutions. Only science can assimilate science."

Mailed Saturday, October 3rd, 1936.